INTERNAL MIGRATION AS A DRIVER OF REGIONAL ECONOMIC GROWTH: SPATIAL SPILLOVERS AND POLICY IMPLICATIONS FROM TURKEY

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ABSTRACT

Internal migration constitutes a key mechanism shaping the demographic structure and regional economic dynamics of a country. Migration flows may generate productivity gains and agglomeration advantages in certain regions, while simultaneously imposing socio-economic pressures on others. Through its influence on labour allocation, human capital distribution, regional demand patterns, and investment behaviour, internal migration plays a decisive role in long-term growth trajectories. This study empirically investigates the relationship between internal migration and economic growth across Turkish provinces at the NUTS-3 level for the period 2008–2020. Given the pronounced spatial interdependencies inherent in migration processes, the analysis employs spatial panel data models and extends the Solow–Swan framework by incorporating internal migration as an additional factor. The findings reveal significant spatial dependence in migration patterns and demonstrate that the effects of internal migration on provincial growth vary systematically across regions. While the direct impact of internal migration on economic growth is negative and statistically insignificant, its indirect (spillover) and total effects are positive and statistically significant. These results highlight that the growth implications of internal migration materialize primarily through spatial interaction mechanisms. Accordingly, effective evaluation of migration–growth linkages require policy approaches that account for regional interconnectedness rather than treating provinces as isolated units.

Keywords: *Economic Growth, Internal Migration, Spatial Panel Data, Regional Economics.*

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1. INTRODUCTION

Economic growth constitutes a central component of national development processes and plays a decisive role in enhancing social welfare and strengthening long-term productive capacity. The sustainability of economic growth is shaped not only by physical capital accumulation but also by the dynamics of human capital, technological progress, institutional structures, and demographic movements. In this context, internal migration emerges as a critical spatial mechanism particularly in countries undergoing rapid economic and social transformation. Motivated by the pursuit of improved living standards and greater economic opportunities, individuals relocate across regions, thereby influencing the growth trajectories of both origin and destination areas through multiple economic channels. The economic implications of internal migration have been widely debated in the literature through mechanisms such as the spatial redistribution of human capital, labor market adjustments, production structures, and regional competitiveness (Barro & Sala-i-Martin, 1992). Migration may enhance economic efficiency by reallocating productive labor towards regions with higher returns to skills and capital, and it may further promote productivity and agglomeration economies in receiving regions (Krugman, 1991). However, excessive migration inflows may generate pressures on infrastructure, housing markets, and public services, leading to congestion costs and diminishing marginal benefits (Fujita & Thisse, 2002). Conversely, sending regions often face declines in human capital stocks, contraction in labor markets, reduced agricultural or local production, and losses in economic vitality (Borjas, 1999).

The relationship between internal migration and regional economic growth is thus both a cause and a consequence of persistent regional disparities. More developed regions—characterized by superior infrastructure, larger labor markets, and greater investment capacity—tend to attract migrants, while less developed areas experience cumulative disadvantages associated with the outflow of human capital. This dynamic may intensify interregional imbalances over time and limit the effectiveness of national development strategies (Harris & Todaro, 1970). Therefore, internal migration should be viewed not merely as a demographic adjustment, but as a fundamental force reshaping regional economic structures. A rigorous understanding of this relationship requires an analytical framework that explicitly incorporates spatial dependence and spillover mechanisms. Tobler's First Law of Geography (1970), asserting that "nearby units are more related than distant ones," highlights the interdependence among regional economic outcomes. Internal migration, inherently spatial in nature, implies that economic performance in one province may be influenced not only by its own characteristics

but also by the economic dynamics of adjacent provinces. Ignoring these interactions may lead to biased or inefficient estimates in empirical models. Spatial econometric methods offer a powerful alternative to conventional regression techniques in such contexts. Traditional models are incapable of capturing spatial autocorrelation and may yield misleading inferences when spatial interactions are present (Anselin, 1998). LeSage and Pace (2009) argue that accounting for spatial feedback effects and spillovers is essential for accurately identifying the mechanisms driving regional growth. Because internal migration is embedded in spatial networks, spatial panel data models provide a more robust empirical framework for assessing its direct and indirect effects on regional economic performance. Internal migration has played a particularly prominent role in shaping Turkey's regional development patterns. Large-scale population flows from Eastern and Southeastern Anatolia toward the western provinces have fundamentally reconfigured the economic geography of the country. Official statistics indicate that provinces offering higher income levels, diversified employment opportunities, and advanced infrastructure attract the majority of migrants. While migration inflows may stimulate growth in receiving areas, sending regions often face slower development, labor shortages, and demographic imbalances, thereby deepening regional inequalities.

Against this background, the present study investigates the impact of interprovincial internal migration on regional economic growth in Turkey over the 2008–2020 period using spatial panel data models. Building on the Augmented Solow–Swan framework, internal migration is introduced as an additional determinant of regional growth alongside human capital, physical capital, technology, and labor. This approach enables the simultaneous estimation of both direct effects and spatial spillover effects associated with migration flows.
This study addresses two interrelated research questions: (i) whether internal migration exerts a statistically significant effect on regional economic growth in Turkey, and (ii) whether this relationship is conditioned by spatial dependence and interprovincial spillover mechanisms. In line with these questions, the analysis explicitly distinguishes between direct (within-province) and indirect (between-province) effects within a spatial econometric framework. Accordingly, the study advances two testable hypotheses. Hypothesis 1 posits that internal migration has a direct effect on regional economic growth, reflecting the contribution of population movements to local labor supply, human capital accumulation, and agglomeration economies. From a theoretical standpoint, the expected sign of the direct effect is positive, as migration toward economically dynamic provinces is likely to enhance productivity through scale effects and improved factor allocation, consistent with endogenous growth and augmented Solow–Swan

frameworks. Hypothesis 2 asserts that the growth effects of internal migration extend beyond provincial boundaries and are transmitted through spatial interaction channels. In particular, migration flows are expected to generate positive indirect (spillover) effects by influencing neighboring provinces via labor market linkages, commuting networks, knowledge diffusion, and demand-side externalities. These mechanisms imply that internal migration may stimulate growth in adjacent regions even when the direct local impact is weak or statistically insignificant, highlighting the importance of spatial dependence in regional growth processes. By explicitly modeling both direct and indirect effects, this study contributes to the literature through the adoption of a spatially explicit augmented Solow–Swan model applied to a comprehensive province-level dataset for Turkey. This approach allows for a more nuanced interpretation of migration–growth linkages and avoids potential biases arising from omitted spatial interactions. The findings are expected to offer meaningful implications for regional development and migration policy, particularly by emphasizing that the economic consequences of internal migration are not confined to destination provinces but diffuse across space through interconnected regional systems.

2. INTERNAL MİGRATİON AND ECONOMİC GROWTH İN TURKEY

Internal migration has remained a central subject of inquiry across the social sciences due to its enduring prevalence and the breadth of its economic and societal implications. Population movements motivated by economic opportunities, social dynamics, cultural preferences, or environmental pressures reshape the spatial distribution of individuals and trigger long-term transformations in regional economic structures and institutional arrangements. Because migration flows differ in scale, duration, and direction, the phenomenon demands a multidisciplinary approach. Sociological analyses focus on integration and adaptation processes; geographical perspectives emphasize spatial mobility patterns and regional restructuring; political science highlights governance responses; and historical accounts trace the cumulative effects of mobility on societal change. Within economics, however, internal migration is conceptualized primarily as a mechanism of labor mobility and a determinant of the spatial allocation of human capital, influencing productivity, labor market efficiency, and long-run regional growth potential. Conceptual frameworks developed in the migration literature further emphasize the multidimensional nature of population mobility. While classical models describe migration decisions as responses to push and pull factors, more recent approaches underscore the roles of income disparities, institutional constraints, social expectations, and environmental risks in shaping internal mobility. In this sense, internal

migration emerges as an outcome of heterogeneous regional conditions related to employment prospects, quality-of-life indicators, and differences in access to public services (Çınar, 2025:24-25).

In Turkey, internal migration has become particularly significant due to the country's rapid structural transformation since the mid-twentieth century. The acceleration of rural-to-urban migration in the post-war period coincided with industrialization, the expansion of non-agricultural employment opportunities, and improvements in urban infrastructure. Simultaneously, agricultural mechanization and declining labor demand in rural areas weakened traditional livelihoods, intensifying the incentives for population movement. By the 1980s, industrial expansion, rising educational aspirations, and evolving social norms had consolidated internal migration as a key driver of Turkey's demographic and economic reconfiguration. Despite its economic underpinnings, internal migration in Turkey is shaped by a broader set of factors, including demographic pressures, land scarcity, limited rural services, and localized conflicts. Consequently, development plans since the 1960s have repeatedly emphasized the need to understand and manage the regional implications of migration. Given its role in redistributing human and physical capital, altering labor market structures, and influencing regional productivity, internal migration remains central to debates on spatial inequality and regional development. Analyzing its relationship with economic growth therefore requires a framework that accounts for regional heterogeneity and spatial interdependence, recognizing that migration affects not only sending and receiving provinces but also the broader network of interregional economic interactions.

2008–2020 Arithmetic Average (Provinces)	Net Internal Migration (Positive)	2008–2020 Arithmetic Average (Provinces)	Net Internal Migration (Negative)
Ankara	2370,260	Rize	-19,98224
Antalya	1584,35	Artvin	-27,99408
İzmir	1387,656	Karaman	-31,5147
Kocaeli	1382,946	Kırşehir	-48,63905
Tekirdağ	1288,532	Mersin	-54,63905
Bursa	1156,337	Kilis	-59,76923
İstanbul	1079,402	Amasya	-61,86982

Muğla	686,1242	Osmaniye	-64,30177
Eskişehir	508,721	Nevşehir	-64,36686
Sakarya	402,6035	Aksaray	-84,18934
Aydın	398,5147	Trabzon	-86,61538
Çanakkale	376,1715	Ordu	-97,14201
Balıkesir	332,2130	Gaziantep	-104,0473
Yalova	219,7810	Bingöl	-123,3609
Bolu	153,9053	Samsun	-125,7100
Kayseri	147,8224	Kütahya	-129,6508
Düzce	140,9053	Ardahan	-135,6627
Kırklareli	120,7041	Batman	-143,4378
Denizli	117,8224	Niğde	-144,0591
Karabük	76,66272	Konya	-144,1065
Bilecik	63,52662	Iğdır	-151,591
Manisa	59,5147	Malatya	-162,3491
Sinop	58,32544	Elazığ	-164,5384
Giresun	50,86390	Kırıkkale	-174,2071
Kastamonu	49,57988	Afyonkarahisar	-210,6982
Edirne	49,14792	Şırnak	-232,3491
Isparta	45,86390	Hakkari	-252,1005
Burdur	43,56804	Siirt	-308,6213
Çankırı	34,55029	Sivas	-324,5029
Bartın	27,62721	Tokat	-347,1420
Uşak	18,79881	Bitlis	-373,7633
Erzincan	16,34319	Çorum	-387,8934
Bayburt	5,402366	Zonguldak	-398,9940
Tunceli	3,426035	Kahramanmaraş	-410,3195
Gümüşhane	0,520710	Adıyaman	-446,1005
		Hatay	-468,2189
		Kars	-474,3491
		Yozgat	-572,6213

		Mardin	-595,1656
		Muş	-659,9881
		Adana	-747,9526
		Erzurum	-819,5976
		Diyarbakır	-920,739
		Şanlıurfa	-950,5088
		Ağrı	-1029,183
		Van	-1123,946

Table 1: Provincial Net Internal Migration Arithmetic Averages in Turkey, 2008–2020

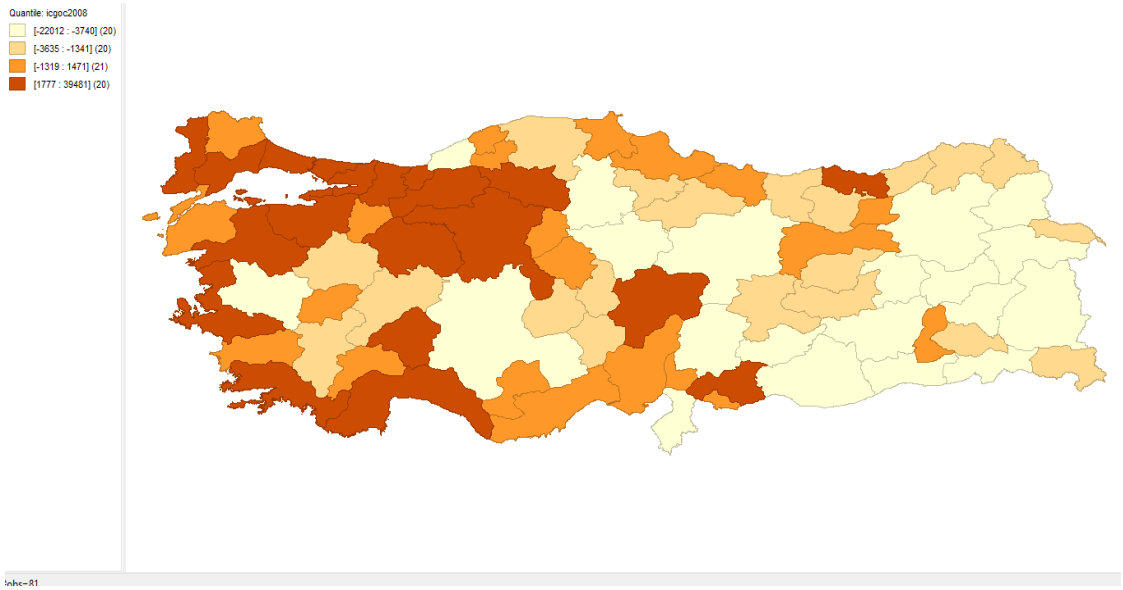
Source: Prepared using data from the Turkish Statistical Institute (TurkStat).

The net internal migration patterns observed across Turkish provinces during the 2008–2020 period reveal a markedly heterogeneous structure shaped by the diverse socio-economic characteristics, demographic profiles, and spatial positions of the regions. As shown in Table 1, metropolitan provinces predominantly exhibit positive net internal migration over the study period. This outcome is closely associated with their relatively advanced labor markets, diversified production structures, and more developed education and health infrastructures, all of which enhance their overall attractiveness. Among these provinces, Istanbul stands out as both the largest origin and destination of internal migration flows, functioning as the core of nationwide population movements. Nevertheless, Istanbul's initially positive net migration position—maintained until 2013—shifted into a pronounced net outflow after 2015. Rising living costs, mounting pressures in the housing market, population density, and the increasing strain on urban infrastructure are key factors underlying this reversal.

In contrast, provinces with weaker economic structures and predominantly rural characteristics consistently record negative net internal migration, underscoring the decisive role of regional development disparities. Limited employment opportunities, relatively low wage levels, and constrained access to social services drive population outflows from these regions toward major metropolitan centers. While metropolitan provinces generally maintained positive net migration between 2008 and 2014, the post-2015 period marks a turning point, with certain large cities—most notably Istanbul—experiencing substantial net migration losses. Provinces such as Kocaeli and Bursa, where manufacturing activity is concentrated, as well as Sakarya, which functions as a regional center for services and trade, report positive net internal migration in most years. These patterns highlight the influence of economic activity and industrial

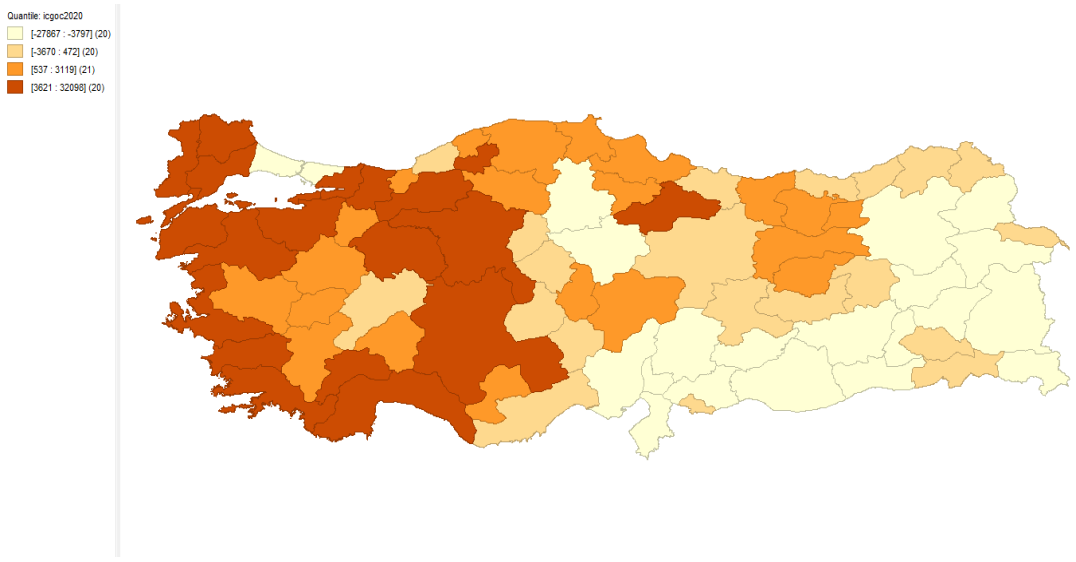
specialization in shaping migration decisions. Similarly, the positive net migration rates observed in provinces like Mersin and Şanlıurfa point to the role of local economic dynamism and relatively affordable living conditions. Conversely, many provinces in Eastern and Southeastern Anatolia (including Diyarbakır, Van, Ağrı, and Muş) experience persistently negative net migration, illustrating how regional inequalities are continuously reproduced through migration flows.

Overall, the internal migration patterns observed between 2008 and 2020 demonstrate that economic opportunities, cost-of-living dynamics, demographic structures, and the level of regional development jointly shape migration flows across Turkey. The fact that metropolitan provinces simultaneously attract and, in certain periods, lose population illustrates the multidimensional and dynamic nature of internal migration in the country. Persistent outmigration from rural and less developed areas further signals a deepening risk of regional inequality, while population pressures in major urban centers impose substantial demands on urban infrastructure and social services. In this context, a detailed examination of internal migration dynamics is crucial for informing regional development strategies and policy design in Turkey. To provide a clearer visualization of the spatial distribution of internal migration, the study presents a set of maps illustrating the provincial patterns for the period 2008–2020 as well as the rate of change in net internal migration across the same interval.



Map 1: Spatial Distribution of Internal Migration Across Provinces in Turkey (2008)
Source: Prepared using data from the Turkish Statistical Institute (TurkStat).

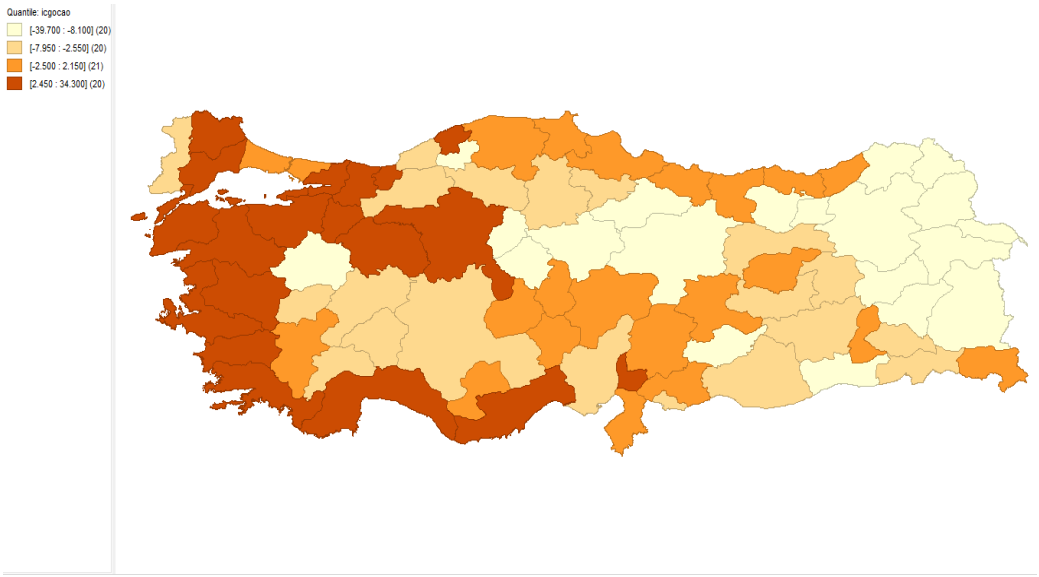
Map 1 presents the spatial distribution of net internal migration across Turkish provinces in 2008, constructed using data from the Turkish Statistical Institute and visualized in GeoDa. Provinces are classified into four categories based on their net internal migration levels. Those displayed in the darkest shade represent provinces with the highest positive net migration, predominantly concentrated along the Marmara, Aegean, and Mediterranean coastal corridors. Provinces depicted in the second-darkest shade also exhibit positive net migration, albeit at a lower magnitude, and are largely situated in selected subregions of the Black Sea and Mediterranean regions. The third shade corresponds to provinces experiencing negative net migration, indicating areas of population outflow; these provinces cluster primarily in the interior sections of the Black Sea Region and in parts of Central Anatolia. Provinces shaded in the lightest tone represent areas experiencing the most severe levels of negative net migration, located mainly in the eastern portions of Central Anatolia as well as across Eastern and Southeastern Anatolia. Overall, the spatial configuration displayed in Map 1 underscores the extent to which internal migration in Turkey is shaped by regional disparities in economic opportunities, living conditions, and socio-economic development.



Map 2: Spatial Distribution of Internal Migration Across Provinces in Turkey (2020)
Source: Prepared using data from the Turkish Statistical Institute (TurkStat).

Map 2 illustrates the spatial distribution of net internal migration in 2020, based on Turkish Statistical Institute data and generated through spatial classification procedures in GeoDa. As in Map 1, provinces are grouped into four categories. The darkest shade again represents provinces with the highest levels of positive net migration, concentrated largely in the

Marmara, Aegean, and Mediterranean regions. The second-darkest category includes provinces with moderate but still positive net migration levels, primarily located in specific segments of the Black Sea and Aegean regions. The third shade reflects provinces where low levels of positive net migration coexist with emerging negative values in certain cases, and these provinces cluster mainly in Central Anatolia and parts of the Eastern Black Sea Region. The lightest shade identifies provinces with the highest levels of negative net migration, which are overwhelmingly concentrated in Eastern and Southeastern Anatolia. Taken together, the spatial patterns observed for 2020 reveal a pronounced clustering of migration dynamics, signaling persistent and spatially structured regional disparities.



Map 3: Spatial Distribution of Internal Migration Across Provinces in Turkey (Arithmetic Averages)

Source: Prepared using data from the Turkish Statistical Institute (TurkStat).

Map 3 presents the arithmetic average of net internal migration for the period 2008–2020, constructed using Turkish Statistical Institute data and processed in GeoDa. The map classifies provinces into four categories based on their long-term average migration values. Provinces shown in the darkest shade correspond to areas with persistently high positive net migration, which are predominantly located in the western part of the country, particularly across the Marmara, Aegean, and Mediterranean regions. The second-darkest category comprises provinces with moderate positive values or near-zero negative values, clustering mainly in parts of Central Anatolia and the Black Sea Region. The third shade represents provinces with substantial negative average net migration, concentrated largely in Central Anatolia. Finally,

provinces depicted in the lightest tone correspond to areas experiencing the most severe average negative net migration, heavily concentrated in Eastern and Southeastern Anatolia. The long-term spatial distribution documented in Map 3 highlights the stability and persistence of regional migration disparities, confirming the presence of a strong spatial clustering pattern in internal migration throughout the 2008–2020 period.

3. LİTERATURE REVİEW

Two elements are particularly central in economics. In the context of economic analysis, rationality has two key dimensions. First, applicable to both non-strategic and strategic reasoning, rational behaviour involves the ability to give up short-term benefits in favour of longer-term outcomes. Second, as the defining feature of strategic rationality, individuals choose their courses of action based on their preferences and their expectations regarding the behaviour of others (Agarwal, 2025). Within this framework, migration decisions can be understood as rational choices in which individuals weigh immediate costs against anticipated long-term gains, while also forming expectations about labour market conditions, social networks, and institutional responses in destination regions (Snidal, 2016; Murali and Muppidi, 2024: 6). Migration constitutes a multidimensional process that encompasses economic, social, cultural, and political components, positioning the phenomenon at the crossroads of several scholarly fields. As a result, the interaction between migration and economic performance has produced a broad and continually expanding literature, spanning varied historical contexts, regions, methodological designs, and forms of population movement. Although much of this research centers on the contribution of migration to economic growth, empirical outcomes differ substantially across studies due to variations in data quality, sample characteristics, migration types, and econometric methods. Even so, a considerable body of evidence indicates that migration promotes economic growth both directly—by expanding the labor force, increasing human capital, and improving productivity—and indirectly through demographic restructuring, technological dissemination, and gains in total factor productivity.

Foundational studies have laid the groundwork for understanding this relationship. Whyte (1972), analyzing European cases, highlights the productivity-enhancing effects of migrant labor, noting that even temporary movements can yield lasting benefits when they contribute to permanent settlement. Brezis and Krugman (1993), using panel data techniques, show that while migration may initially suppress real wages, productivity improvements lead to long-run wage growth. Incorporating human capital into an Augmented Solow–Swan model, Dolado,

Goria, and Ichino (1994) find that migration's growth effects depend on pre-existing human capital levels in OECD economies. Research inspired by the Walz–Lucas tradition likewise argues that skilled labor mobility accelerates capital formation and strengthens long-term growth paths.

Zlotnik (1998) underscores the increasing importance of international migration in shaping global economic outcomes after 1965. Examining macroeconomic drivers, Jennisen (2003) reports that higher per capita income increases net migration in Western Europe, whereas unemployment discourages it. Evidence from Mete (2004) indicates that migration raises Finland's GDP in the short run despite no long-run cointegration with growth. In China, Fang and Dewen (2007) demonstrate that internal migration played a central role in enhancing labor mobility and stimulating growth during the reform era. Orefice (2010) shows that while migration has limited short-term effects in OECD host countries, it entails human capital losses for sending economies. Studies by Boubtane, et al. (2013), Gonzalez-Gomez and Giraldez (2011), Cooray (2012), Salahuddin and Gow (2015), and Ekanayake and Moslares (2020) further document that migration and remittances support income growth, sustain labor markets, and reduce poverty. From a historical standpoint, Foldvari, Van Leeuwen, and Van Zanden (2013) examine the Netherlands during 1570–1800 and, using VAR methods, report a direct and positive influence of migration on per capita income. Investigating the determinants of migration flows, Ortega and Peri (2013) show that economic prospects are the primary driver of migration to high-income destinations. Incorporating migration into a Solow–Swan framework, Boubtane et al. (2014) find that skilled migrant inflows significantly strengthen economic growth. More recent studies reinforce these conclusions. Bove and Elia (2017) document a positive contribution of labor migration to GDP in advanced economies, whereas Furlaretto and Robstad (2019) show that immigration raises economic growth and lowers unemployment in Norway in the short run. Focusing on high-skilled mobility, Oliinyk (2021) identifies a strong positive association between high-skilled migration and economic growth across EU member states. Similarly, Sazzad and Pedi (2021) conclude that internal migration in India continues to support regional economic growth despite tendencies toward convergence. Among the latest contributions, Ananta et al. (2023) demonstrate that internal migration and ethnic diversity enhance Indonesia's economic performance under specific demographic and institutional settings. Wang (2023) finds that internal migration in China's autonomous regions contributes to growth by reducing poverty. For G7 economies, Akın et al. (2024) identify a one-way causal relationship running from economic growth to outward

migration. Kozlovskyi et al. (2024) confirm the positive developmental effects of migration for European economies, while Pan and Sun (2024) report that remittances accelerate structural transformation and improve social welfare.

A complementary body of work notes that migration may yield adverse outcomes under certain conditions. Lipton (1980) shows that rural–urban migration driven by income disparities increases both intra- and inter-regional inequalities. Amuedo-Dorantes and Pozo (2004) report that remittances transmitted through real exchange-rate appreciation harm competitiveness in Latin American and Caribbean economies. Chami, Fullenkamp, and Jahjah (2005) similarly find that, unlike foreign investment, remittance inflows correlate negatively with GDP. Morley (2006), employing an ARDL approach for Australia, Canada, and the United States, identifies a long-run causal link from income to migration, with no reverse effect. In Europe, Fratesi and Riggi (2007) argue that skill-selective migration may exacerbate income disparities, while Kim (2007) shows that remittances reduce labor-force participation in Jamaica. Additional evidence from Wouters and Taylor (2008), Coulombe and Tremblay (2009), Chletsos and Raoupakias (2012), Nyamongo et al. (2012), and Ager and Brückner (2013) further demonstrates that migration can influence agricultural activity, regional inequality, growth volatility, and cultural polarization in ways that may hinder long-run economic performance. In the South African context, Chamunorwa and Mlambo (2014) identify a positive linkage between migration rates and unemployment, while the effects of migration on other key macroeconomic indicators remain relatively modest. Katsushi et al. (2014), analyzing 24 Asia–Pacific economies, observe that although remittances contribute to economic expansion, instability in these inflows triggers fluctuations in output. Examining rural China, Wang (2014) finds that migration and remittances generate meaningful gains for middle- and upper-income households, yet their benefits for low-income groups are minimal. Likewise, Lim and Simmons (2015) show that in Caribbean economies remittances bolster long-run consumption patterns but do not translate into productivity improvements. Using panel cointegration methods for 17 OECD countries, Ogunleye (2016) reports a negative long-term association between per capita GDP and international labor migration, alongside evidence that unemployment discourages outward mobility. For Croatia, Borozan (2017) documents that internal migration adversely affects economic growth, while Stojanov et al. (2019) demonstrate that remittance instability undermines sustainable development in emerging economies. Islam (2021), studying Bangladesh, identifies a negative relationship between increases in migrant outflows and GDP, and concludes that remittance volatility weakens overall economic performance. More recent

studies reinforce these concerns. İslamoğlu and Çoban (2024), employing a Panel Granger causality model for 20 European economies over 2008–2021, find unilateral causality running from migration to economic growth, with no evidence of reverse causation. Sevinç (2024) further shows that rural–urban migration in Turkey produces significant declines in agricultural and livestock activity, thereby exerting a contractionary influence on aggregate output.

Çınar and Has (2024) Migration refers to the movement of individuals from one region to another, while the agriculture, industry, and services sectors constitute the core pillars of the Turkish economy. In the pursuit of catching up with developed economies, countries attach significant importance to the concepts of economic growth and development. Within this context, this study examines the regional impact of internal migration on economic growth in Türkiye. The analysis covers the period from 2008 to 2021 and focuses on NUTS-3 regions. Using Granger causality analysis, the study investigates the causal relationships between internal migration and economic growth at the provincial level. By employing the most up-to-date data and analyzing the growth effects of internal migration at the disaggregated regional level within a consistent empirical framework, the study makes a distinct contribution to the existing literature. The empirical findings reveal the existence of strong causal relationships at the 1% significance level running from internal migration, agriculture–forestry–fisheries, industry, and services sectors to economic growth. Akın, Dinçer, and Özdemir (2024) investigate the panel causality relationships among migration, economic growth, and carbon emissions in G-7 countries, revealing bidirectional causal linkages between migration and economic growth. Bujor (2025) analyzes the effects of net migration on economic growth, measured by GDP per capita, and employment in selected Eastern European countries, including Romania, Bulgaria, Poland, and Hungary, employing panel data techniques. The results suggest that net migration contributes positively to overall economic performance. Finally, Luz, Neves, Afonso, and Sochirca (2025) conduct a meta-analysis that systematically assesses the effects of immigration on key economic outcomes such as economic growth, productivity, unemployment, and innovation, highlighting the heterogeneous nature of migration's economic impacts across host countries. Çınar (2025) analyzes the impact of migration on economic growth and finds that direct and indirect effects differ, with the indirect effect being statistically significant. Taken together, this body of research highlights that the economic repercussions of migration are not uniform. Under certain structural, demographic, and institutional configurations, migration may generate unequal income effects, compress labor supply, reduce productivity, or heighten macroeconomic volatility—ultimately posing

risks to sustainable growth. Overall, findings suggest that migration can, under some conditions, exert contractionary effects on national or regional economies. Income disparities, remittance instability, labor-market frictions, and sectoral shifts are central mechanisms through which these adverse outcomes may emerge. Despite extensive inquiry, the literature has not reached a definitive consensus, as empirical results vary widely depending on methodological design, geographical and temporal coverage, and the specific migration indicators applied. Within this literature, commonly used indicators include in-migration, net migration, and remittance inflows. Evidence based on in-migration typically indicates that recipient economies benefit when they can attract and integrate highly skilled labor, which enhances human capital accumulation, strengthens labor-market outcomes, and stimulates aggregate demand. Studies employing net migration indicators report more mixed findings, shaped by institutional quality, demographic structure, and country-specific characteristics. Research centered on remittances generally demonstrates that they support growth by easing credit constraints and promoting consumption and investment, although volatility in these inflows can offset their positive effects. Studies identifying positive migration–growth linkages emphasize that rural–urban mobility expands the urban labor pool, raises household income, and reinforces consumption and investment channels, thereby stimulating public investment and strengthening overall economic performance. Conversely, negative findings stress that rapid population inflows may place pressure on social infrastructure, intensify unemployment and poverty, and deepen allocative imbalances. Accordingly, migration is understood not only as an economic process but also as a driver of regional disparities and socio-economic transformation. Against this backdrop, the present study examines the relationship between internal migration and economic growth across Turkey's NUTS-3 regions. The empirical model is grounded in the Augmented Solow–Swan framework developed by Dolado et al. (1994) and Augmented by Boubtane et al. (2014). To the best of our knowledge, this study represents the first application of this expanded growth model to evaluate the migration–growth nexus within Turkey's regional context, thereby offering a novel empirical contribution.

The analysis employs spatial panel econometric models to capture spatial dependence in both migration outcomes and economic performance. Integrating spatial methods is essential for identifying spillover effects, understanding localized dynamics, and guiding more effective regional development strategies. Assessing the economic consequences of internal migration from a spatial perspective thus provides policymakers with a more nuanced basis for regional

planning, resource allocation, and the design of inclusive development frameworks attuned to Turkey's geographic realities.

4. DATA, MODEL AND METHOD

This study investigates the relationship between internal migration and economic growth across NUTS-3 regions in the Turkish economy. The empirical analysis is conducted at the provincial level, covering all 81 provinces of Turkey. While provincial gross domestic product (GDP) serves as the dependent variable, the explanatory variables include net migration (in-migration minus out-migration), technological capacity indicators, measures of human capital, and physical capital variables. Provincial GDP and public investment figures are first deflated to obtain real values; subsequently, GDP, net migration, and real public investment are normalized by population to derive per capita measures, which are used in the econometric analysis. This approach is adopted to more accurately capture regional disparities. The analytical framework is grounded in the Augmented Solow–Swan growth model. Building on the classical economic growth formulation proposed by Mankiw et al. (1992), the model integrates internal migration as an additional factor to assess the spatial implications of migration for Turkey's economic growth. Definitions, descriptions, and data sources of all variables employed in the analysis are presented in Table 2.

Variables	**Abbreviation**	**Description**	**Source**
GDP	lngdp	Provincial Gross Domestic Product (USD)	TURKSTAT
Net Migration	lnmig	Provincial Net Migration	TURKSTAT
Technology	lntech	Number of Registered Patents by Province	TPE
Human Capital	lnhc	Number of Postgraduate Graduates by Provinces	YOK
Physical Capital	lninv	Provincial Public Investments	SBB
Labour	lnpop	Provincial Population	TURKSTAT

Table 2: Descriptions of Variables Used in the Analysis

TURKSTAT: Turkish Statistical Institute

TPE: Turkish Patent Institute

YOK: Council of Higher Education

SBB: Presidency of Strategy and Budget

Mankiw et al. (1992) extend the classical Solow–Swan growth framework by incorporating human capital into the production process, thereby providing a more comprehensive perspective on the determinants of economic growth. While the traditional model explains growth primarily through physical capital accumulation, labor expansion, and technological progress, it falls short of fully accounting for cross-country and long-run growth differentials. The Augmented approach addresses this limitation by treating human capital—particularly education, skills, and accumulated knowledge—as a fundamental component of production, enabling a more refined analysis of growth dynamics. In this framework, the production function is expressed with the parameters α and β, which capture the output elasticities of physical and human capital, respectively:

$$Y(t) = K(t)^{\alpha} H(t)^{\beta} [A(t)L(t)]^{1-\alpha-\beta} \qquad (1)$$

where

Y(t) denotes total output,

K(t) physical capital,

H(t) human capital,

L(t) labor, and

A(t) the level of technological progress.

The Augmented model examines the influence of physical capital accumulation (s_k), investment in human capital (s_h), and population growth (n) on long-run steady-state growth. By explicitly incorporating education, knowledge, and skills into the growth mechanism, it offers a stronger explanatory framework for income differentials across countries and regions, positioning human capital as a central determinant of economic growth potential. Consequently, the model provides policymakers with a robust analytical basis for evaluating how investments in education, health, and innovation shape long-term growth trajectories.

In the empirical application focusing on Turkey, the study analyzes the economic effects of internal migration for 81 provinces over the period 2008–2020. The findings reveal that internal migration exhibits a clustered spatial pattern across provinces, suggesting the presence of spatially sequential dependence driven by neighborhood effects. Such clustering raises the expectation of potential spillover effects across regions. When spatial dependence is inherent in the variables under study, ignoring this structure may undermine the reliability of econometric estimates. Even if OLS estimators remain unbiased and consistent, they lose efficiency in the presence of spatial dependence (Anselin, 1998).

Accordingly, spatial econometric techniques offer a suitable methodological framework for examining how economic, demographic, and social conditions in a given region might influence outcomes in geographically proximate regions. These methods provide substantial advantages for identifying regional heterogeneity, capturing the unique dynamics of each province, and assessing regional policy implications more accurately. While classical cross-sectional models assume independence across observations, spatial models allow for direct and indirect interactions between variables (LeSage & Pace, 2009).

Spatial econometric models distinguish among three main types of interactions: endogenous dependence in the dependent variable, exogenous interactions among explanatory variables, and spatial correlation in the error terms. The core models of spatial econometrics are the Spatial Autoregressive (SAR) model and the Spatial Error Model (SEM). The SAR model—often referred to as the spatial lag model—captures endogenous interaction effects, whereas the SEM model focuses on spatial dependence embedded in the error term (Elhorst, 2014). A more general specification that incorporates both endogenous interaction effects and spatially correlated errors is the Spatial Durbin Model (SDM), as defined by Anselin (1998).

The Spatial Durbin Model (SDM) is specified as follows:

$$y = \rho W y + \alpha \iota_n + X\beta + WX\theta + \varepsilon \qquad (2)$$

$$\varepsilon = \lambda W \varepsilon + u \qquad (3)$$

Within the spatial econometric framework, the SDM is regarded as one of the most general model formulations. In this specification, the parameter λ captures the spatial autoregressive process in the error term, ρ represents the endogenous spatial lag coefficient, and α denotes the intercept term. When the number of explanatory variables is K, W refers to the $n \times n$ spatial weight matrix, y is an $n \times 1$ vector of the dependent variable, and X is an $n \times K$ matrix of explanatory variables. The parameter vectors β and θ are $K \times 1$ vectors of coefficients. The term Wy represents the spatial lag of the dependent variable, while WX denotes the spatially lagged explanatory variables.

When $\theta = 0$ and $\lambda = 0$, the model reduces to the Spatial Autoregressive (SAR) model, also referred to as the spatial lag model, in which spatial dependence arises solely through the endogenous lag of the dependent variable and no spatial lags of the regressors are included. Solving for y yields the SAR representation:

$$y = (I - \rho W)^{-1} X\beta + (I - \rho W)^{-1} \varepsilon \qquad (4)$$

If ρ = 0, the model collapses into the Spatial Error Model (SEM) as described in Anselin (1988):

$$y = X\beta + (I - \lambda W)^{-1}u \qquad (5)$$

Introducing the time dimension, denoted by subscript *t*, transforms these models into panel-data spatial specifications. In the presence of spatial dependence, coefficients obtained from SAR or SDM models cannot be interpreted in the same manner as conventional panel regression estimates. The reason is that structural changes occurring in one region may influence not only its own outcome but also the outcomes of geographically connected neighboring regions through spatial spillovers. This interdependence is embedded in the models via endogenous spatial lags (ρWy) and the spatial lags of explanatory variables (WX) (LeSage and Pace, 2009: 33–36).

Hence, evaluating SAR and SDM results requires more than inspecting structural parameter estimates; it necessitates decomposing the marginal effects implied by these parameters. Marginal effects are typically categorized into direct, indirect (spillover), and total effects. The direct effects measure the impact of a one-unit change in an explanatory variable within a given region on the dependent variable of the same region. The indirect or spillover effects capture how changes occurring in neighboring regions influence outcomes in the region under consideration. The total effects, obtained by summing the direct and indirect components, represent the overall or global influence of the variable of interest (Elhorst, 2014: 17–19).

Accordingly, the decomposition and reporting of marginal effects constitute an essential requirement for deriving economically meaningful, consistent, and comprehensive interpretations of spatial interaction mechanisms within SAR and SDM frameworks.

5. FINDINGS AND EVALUATION OF FINDINGS

The study also reports the results obtained using the Ordinary Least Squares (OLS) estimator. OLS serves as a fundamental benchmark owing to its desirable properties of being the best, linear, and unbiased estimator under the classical assumptions. Although OLS findings are presented, the presence of spatial dependence in Turkey's internal migration data necessitates giving primary emphasis to the panel spatial models that explicitly account for spatial interactions. Because spatial dependence limits the interpretive validity of conventional OLS results, the OLS estimates are provided merely for reference purposes. The non-spatial OLS results are presented in Table 2.

Variables	OLS Coef.	OLS Prob.	FE Coef.	FE Prob.	RE Coef.	RE Prob.
lnmig	-3.286	(0.55)	1.738	(0.40)	1.539	(0.47)
lntech	-0.113**	(0.05)	0.075***	(0.00)	0.066**	(0.01)
lnhc	0.102	(0.80)	1.557***	(0.00)	1.458***	(0.00)
lninv	0.050	(0.86)	0.034***	(0.00)	0.035***	(0.00)

Table 3: Results of Ordinary Least Squares, Fixed Effects, and Random Effects Models

Source: Author's own construction

*Note: *** shows significance at the 1% level, ** at the 5% level, and * at the 10% level.*

Statistic	Degrees of Freedom	Probability (p-value)
Chi-square	4	146.22836 (0.00)

Table 4: Hausman Test (Not Spatial)

Source: Author's own construction

Following the OLS estimations, the Hausman test was conducted to determine whether the fixed-effects or random-effects specification is more appropriate for the panel structure of the data. The resulting p-value indicates that the fixed-effects model should be preferred over the random-effects alternative. Accordingly, the analysis concludes that the fixed-effects specification yields more consistent and reliable estimates for examining the relationship between internal migration and economic growth.

However, given that internal migration flows in Turkey exhibit a notable degree of spatial clustering, incorporating spatial dependence and spatial interactions into the econometric framework is essential for obtaining valid inference. To assess the presence of spatial effects in the migration variable, a set of Spatial Dependence Tests—including the LM Lag, LM Error, and Robust LM statistics—was applied. The results of these tests, detailed in Table 4, indicate statistically significant spatial dependence in the internal migration data. This finding suggests that traditional panel data models may fail to fully capture the inherently spatial structure of migration dynamics, thereby underscoring the analytical necessity of employing spatial econometric models.

Test	Value	Prob. (p)
LMlag	30.55	0.00
LMerr	45.82	0.00
Likelihood Ratio (LR)	36 (Calculated)	7.815 (Chi-Square)

Table 5: Results of Spatial Dependence Tests

Source: Author's own construction

After establishing the presence of spatial dependence, the Hausman test was reapplied to determine whether the fixed-effects or random-effects specification is more appropriate within the spatial modeling framework. The test results indicate that, even after incorporating spatial components into the model, the fixed-effects structure remains the preferred specification. This finding implies that the relationship between internal migration and economic growth at the provincial level is influenced by unobserved, time-invariant regional characteristics. Controlling for such heterogeneity is therefore essential for ensuring the reliability and consistency of the estimated coefficients.

To further identify the most appropriate spatial model specification, a Likelihood Ratio (LR) test was conducted. This test enables a comparison between a relatively parsimonious model and a more comprehensive alternative. In this context, the Spatial Autoregressive Model (SAR) was treated as the simpler specification, whereas the Spatial Durbin Model (SDM) was considered the more general form. The LR test is computed as follows:

$$LR = -2 \times (LL_1 - LL_2)$$

where LL_1denotes the log-likelihood value of the SAR model and LL_2represents the log-likelihood of the SDM. The LR statistic was calculated as 36, with 4 degrees of freedom reflecting the four additional parameters included in the SDM relative to the SAR model. Using the chi-square critical value of 7.815 at the 5% significance level, the null hypothesis—*H_0: "The simpler model (SAR) is sufficient"*—is rejected, since the LR statistic substantially exceeds the critical threshold. Accordingly, the results support the adoption of the more comprehensive Spatial Durbin Model.

Taken together, these empirical findings demonstrate that internal migration exhibits a strongly spatially dependent structure, that significant spatial interactions exist across provinces, and that these interactions manifest through complex spatial mechanisms. For these reasons, both

theoretical considerations and statistical diagnostics point to the Spatial Durbin Model with fixed effects (SDM-FE) as the most appropriate specification for the empirical analysis.

$$lngdp_{it}=\alpha_i+\rho(W\cdot loggdp_{it})+\beta_1\cdot ln(tech_{it})+\beta_2\cdot ln(hc_{it})+\beta_3\cdot ln(inv_{it})+\beta_4\cdot goc_{it}+\theta_1(W\cdot ln(tech_{it}))+\theta_2(W\cdot ln(hc_{it}))+\theta_3(W\cdot ln(inv_{it}))+\theta_4(W\cdot goc_{it})+\varepsilon_i t_i$$

$= 1\ldots\ldots\ldots\ldots .. N$ $N = 81$ (represents the cross-sectional dimension)

$t = 13$ (represents the time dimension) $\varepsilon_{it} \sim N(0,\sigma^2 I)$

The variables and parameters included in the spatial panel specification are defined below within an academic framework:

In this specification, ln gdp_it denotes the natural logarithm of real per capita GDP in province *i* at time *t*, serving as the dependent variable and the primary measure of provincial economic performance. The term α_i captures province-specific fixed effects, controlling for unobserved and time-invariant regional characteristics—such as geography, climatic conditions, and natural resource endowments—that may systematically shape growth trajectories. The parameter ρ represents the spatial autoregressive coefficient, indicating the degree to which the economic outcomes of adjacent provinces, reflected in W·ln gdp_it, influence the growth of province *i*. A statistically significant ρ signals the presence of spatial spillover effects.

The expression W·ln gdp_it refers to the spatial lag of the dependent variable, constructed as the weighted average of neighboring provinces' income levels according to the spatial weight matrix *W*. Explanatory variables include ln tech_it, measuring provincial technological capacity; ln hc_it, capturing human capital through indicators such as higher-education graduates; and ln inv_it, reflecting real public investment. migration_it denotes net internal migration on a per-capita basis and is retained in its non-logarithmic form.

Spatially lagged covariates, W·X_it, are included to identify spillover mechanisms originating from neighboring provinces. The associated coefficients, θ_j, quantify these indirect effects and enable the decomposition of total impacts within the SDM framework. Finally, ε_it represents the idiosyncratic error term, assumed to exhibit zero mean and constant variance.

The spatial weight matrix *W*is constructed using the rook contiguity criterion, based on geographic adjacency among Turkey's provinces. Accordingly, in the 81×81 matrix, each

province is assigned a connection only with those provinces with which it shares a direct border.

Additional model-specific definitions are as follows:

p denotes the spatial autocorrelation coefficient, which serves as a key parameter in assessing the direction and magnitude of spatial dependence within the model.
i represents the cross-sectional dimension and corresponds to the 81 provinces of Turkey.
t indicates the time dimension.

Since the dataset covers the period 2008–2020, the panel spans a total of 13 years. Accordingly, the balanced panel consists of 1,053 observations derived from 81 provinces over 13 years.

Variables	**SEM Coefficient (Prob.)**	**SAR Direct**	**SAR Indirect**	**SAR Total**	**SDM Direct**	**SDM Indirect**	**SDM Total**
lnmig	**-0.49 (0.70)**	**-0.07 (0.95)**	**0.006 (0.99)**	**-0.06 (0.97)**	**-1.41 (0.33)**	**9.23 (0.01)****	**7.81 (0.03)****
lntech	**0.07 (0.00)**	**0.06 (0.02)**	**0.05 (0.09)**	**0.12 (0.04)**	**0.05 (0.05)***	**-0.01 (0.81)**	**0.03 (0.73)**
lninv	**0.04 (0.07)**	**0.04 (0.00)**	**0.57 (0.00)**	**1.31 (0.00)**	**-0.05 (0.79)**	**1.67 (0.00)*****	**1.62 (0.00)*****
lnhc	**1.14 (0.00)**	**0.74 (0.00)**	**0.57 (0.00)**	**1.31 (0.00)**	**-0.05 (0.79)**	**1.68 (0.00)*****	**1.62 (0.00)*****
					Hausman: chi2(5) = 0.0004		Prob>=chi2 = 0.00***
					Spatial Rho: 0.429 (0.00)		
					JB Test 72.6 Chi (2) 1.7e-16		

Table 4: Results of the Spatial Effects of Internal Migration on Economic Growth in Turkey

*Note: Significance levels: *** 1%, ** 5%, * 10%.*

*Note: *** significance at the 1% level; ** significance at the 5% level; * significance at the 10% level.*

ME: Marginal Effects; SEM: Spatial Error Model; SDM: Spatial Durbin Model; SAR: Spatial Autoregressive Model.

The fixed-effects estimates of the Spatial Durbin Model (SDM) reported in Table 7 reveal that the impacts of internal migration, human capital, and public investment on provincial economic growth in Turkey exhibit pronounced spatial heterogeneity. The direct effect of internal migration is –1.418 and statistically insignificant at the 10% level, whereas the indirect effect is estimated at 9.235 and is significant at the 1% level. The resulting total effect of 7.816 is significant at the 5% level, indicating that although migration does not generate a direct growth-enhancing effect within provinces, it exerts a substantial positive influence through spillovers originating from neighboring regions. These results suggest that internal migration produces considerable positive externalities across the regional landscape. For the technology variable (lntech), the estimated direct effect of 0.052, indirect effect of –0.019, and total effect of 0.033 all remain statistically insignificant, implying that the technological capacity measures employed offer limited explanatory power for provincial growth within the prevailing spatial interaction structure. Regarding human capital (lnhc), the direct effect is –0.058 and statistically insignificant, yet the indirect effect is 1.687 and the total effect 1.628, both significant at the 1% level. This pattern indicates that human capital contributes to economic performance primarily through interregional diffusion rather than through direct provincial-level effects.

Public investment (lninv) yields a direct effect of 0.036, an indirect effect of –0.066, and a total effect of –0.029, none of which reach statistical significance, suggesting no measurable influence on economic growth in the spatial framework considered. The spatial autoregressive parameter (ρ), estimated at 0.429 and significant at the 1% level, confirms strong positive spatial dependence in economic activity across provinces. Taken together, the SDM findings underscore that economic growth in Turkey is shaped not only by internal migration, human capital, and technology but also by the spatial interconnections that transmit growth impulses across regions. Building on the contributions of Evcim and Yeşilyurt (2023) and Chen (2025), the literature underscores the pivotal importance of spatial interdependence in shaping both economic growth and migration processes. Evcim and Yeşilyurt (2023) revisit the enduring problem of explaining the Solow residual by adopting spatial econometric growth frameworks for the founding OECD economies over the 1996–2019 period. Through the comparison of alternative spatial weight matrices, they show that incorporating spatial structure improves the robustness of parameter estimates and uncovers meaningful cross-country linkages. Their results indicate that technological progress exerts a statistically significant and positive direct effect on output, while its indirect (spillover) effect remains insignificant. A comparable pattern

is observed for investment growth, which positively affects growth only through direct channels. In contrast, human capital accumulation displays consistently positive and significant effects in both direct and indirect dimensions. From a different but complementary perspective, Chen (2025) treats migration as an intrinsically spatial phenomenon and re-examines classical push–pull mechanisms within the broader cumulative causation framework by employing spatial panel data techniques. Concentrating on subregional and fine-grained geographic units across the European Union, the study enriches standard socioeconomic measures with satellite-based nighttime light indicators to proxy local economic activity more accurately. Estimates from fixed-effects spatial panel models point to strong and statistically significant spillover effects: migration flows themselves generate pronounced spatial externalities, while employment opportunities in adjacent regions constitute the most influential pull factor in both the short and long run. Moreover, contrary to conventional theoretical expectations, population density at the local level is found to be negatively associated with net migration. Considered jointly, these studies reveal that indirect spatial effects may be substantial, though their relevance and intensity differ across variables and empirical settings. By demonstrating that direct and indirect impacts frequently diverge, both contributions highlight the methodological necessity of explicitly accounting for spatial dependence. Ignoring such interactions risks producing incomplete or biased conclusions, thereby reaffirming the fundamental role of spatial effects in empirical analyses of economic growth and migration dynamics. In spatial econometric models, the direct effect refers to the marginal impact of a change in an explanatory variable within a given region (or country) on that same region's dependent variable. In contrast, the indirect effect captures the influence of an increase in the explanatory variable that is transmitted to other regions through neighboring units, reflecting cross-regional spillover mechanisms. This conceptual distinction was first systematically grounded by Anselin (1988) within the theoretical framework of spatial autocorrelation and spatial feedback processes. LeSage and Pace (2009) demonstrate that, in spatial lag–type models, estimated coefficients cannot be interpreted as simple marginal effects. This is because a shock originating in one region propagates to other regions through the spatial weights matrix and subsequently feeds back to the originating region. Consequently, they argue that empirical interpretations that do not explicitly decompose total impacts into direct and indirect components are inherently incomplete and potentially misleading.

6. RESULTS AND POLİCY RECOMMENDATİONS

Migration has historically evolved as a multidimensional phenomenon shaped by shifting economic, social, and demographic forces, and its contemporary manifestations continue to influence development trajectories in complex ways. Beyond the physical relocation of individuals, migration constitutes a transformative process that reconfigures regional labor markets, alters the distribution of human capital, and reshapes patterns of demand for public services. As such, internal migration has become a central concern in development debates, interacting with economic growth through both direct causal pathways and mutually reinforcing feedback mechanisms.

The economic implications of migration are not uniform; rather, they vary across contexts and depend on regional characteristics, institutional capacities, and the nature of labor market adjustments triggered by population mobility. While the movement of skilled workers may enhance productivity, promote innovation, and strengthen agglomeration economies, unmanaged population flows can strain infrastructure, exacerbate mismatches in labor supply and demand, and weaken social cohesion. Empirical evidence in the broader literature suggests that migration's effects operate through a set of channels involving human capital redistribution, consumption dynamics, labor reallocation, and structural changes in regional production systems. These channels are particularly salient in developing economies, where internal migration often represents both a response to and a determinant of regional inequality.

In Turkey, where regional disparities in economic performance are longstanding and pronounced, internal migration plays a decisive role in shaping spatial development patterns. The implications of migration extend beyond the provinces that attract or lose population, influencing neighboring areas through spillover mechanisms embedded in regional production networks and interprovincial labor mobility. This study examines these dynamics by analyzing the spatial effects of internal migration on economic growth at the NUTS-3 level during the 2008–2020 period. By explicitly distinguishing between the direct effects on migrant-receiving provinces and the indirect effects transmitted to neighboring regions, the study situates migration within a broader spatial-economic framework.

Drawing on a balanced panel of 81 provinces, the empirical analysis employs the Spatial Durbin Model (SDM) under a fixed-effects specification. Net internal migration per capita serves as the key explanatory variable, while real GDP per capita represents economic

performance. Measures of human capital, technological capacity, physical capital accumulation, and labor force characteristics are integrated as controls. Spatial interactions are modeled through a contiguity-based spatial weight matrix, allowing the estimation to capture both local effects and cross-border externalities.

The results reveal substantial spatial dependence in Turkey's provincial growth patterns. Although the direct effect of internal migration is negative and statistically insignificant—consistent with short-term adjustment pressures faced by migrant-receiving provinces—the indirect and total effects are positive and statistically robust. These findings indicate that internal migration generates beneficial spatial diffusion effects, enhancing productivity and growth in neighboring provinces through labor mobility, knowledge flows, and regional linkages. This pattern echoes insights from New Economic Geography, which emphasizes the role of spatial interaction mechanisms in strengthening regional economic performance.

Human capital displays a similar structure: while its direct effect on growth is insignificant, its indirect and total effects are positive and significant. This suggests that the movement and interaction of skilled individuals generate knowledge spillovers that extend beyond local boundaries. In contrast, technological capacity exhibits a strong and significant direct effect, but minimal spillovers, implying that innovation outcomes remain geographically concentrated and that technological knowledge diffusion remains spatially constrained. Public investment displays neither significant direct nor indirect effects, underscoring long-standing concerns that resource allocation is insufficiently aligned with regional needs and spatial efficiency principles.

Taken together, the empirical evidence suggests that economic growth in Turkey is shaped not only by local conditions but also by the spatial structure of regional interactions. Internal migration and human capital contribute to growth through network effects and spillovers, while deficiencies in the spatial diffusion of public investment and technology weaken regional development outcomes. These findings highlight the need to reconfigure regional development policies around principles of spatial targeting, place-based capacities, and enhanced knowledge and labor mobility.

The broader policy implications stemming from these findings stress the importance of mitigating the short-term adjustment costs associated with migration while reinforcing its positive externalities. This requires the adoption of place-based development strategies aimed

at strengthening endogenous regional capacities. Key priorities include improving the responsiveness of public investment allocations to local needs, enhancing vocational training systems, supporting rural economic activities, expanding transport networks, and encouraging local entrepreneurship. Effective implementation demands coordinated action among central government institutions, local authorities, the private sector, and civil society.

Addressing socio-economic vulnerabilities in migration-affected regions further requires building crisis-response mechanisms, reinforcing social protection systems, and supporting restructuring strategies that help local economies adapt to population shifts. Policies that expand employment opportunities through innovation hubs, public-private partnerships, and local enterprise development can enhance regional resilience. Complementary measures include investing in digital infrastructure, strengthening local development funds, and promoting green transformation initiatives. The diffusion of renewable energy technologies, digitalization practices, and environmentally sustainable production methods can both reduce regional disparities and support broader structural transformation.

Although the study's temporal scope is limited to the 2008–2020 period due to data constraints, expanding the empirical framework with more recent and comprehensive data would enhance the robustness of policy inferences. Nonetheless, the findings underscore a central conclusion: internal migration generates limited direct effects but substantial positive indirect effects on economic growth, indicating that spatial spillovers are integral to the functioning of regional economies. When supported by well-designed policies, migration represents not merely a demographic process but a potential engine for balanced and sustainable regional development in Turkey.

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